suffered a greater than twofold increase in the occurance of lymphomas.[115]

These findings were further evidence implicating RF radiation with cancer causation, as have been additional follow —up findings by Lai and Singh which suggest a possible mechanism by which the radiation causes DNA damage. These researchers conclude that

Data from the present experiment confirm our previous finding that acute RFR exposure causes an increase in DNA single-and double-strand breaks in brain cells of the rat.[116]

14

Many years earlier H. P. Schwan reminded us that the Western standards are based solely on behavioral effects.[117] He observed that some considerations for establishing safety standards are based on economics over safety. In his example, Dr. Schwan points out that a safety standard of 10 mW/cm² would burden the broadcast industry (TV and radio stations) since the field intensities around many antenna sites provide power densities higher than that limit.

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[115] *M. H. Repacholi, A. Basten, V. Gebski, D. Noonan, J. Finnie, and A. W. Harris, "Lymphomas in Eu-Pim1 Transgenic Mice Exposed to Pulsed 900 MHz Electromagnetic Fields," Radiation Research 147 (1997):631-40.*

[116] *H. Lai and N. P. Singh, "Melatonin and a Spin-Trap Compound Block Radiofrequency Electromagnetic Radiation Induced DNA Strand Breaks in Rat Brain Cells," Bioelectromagnetics 18, no. 6 (1997):446-54.*

[117] *H. P. Schwan, "Nonionizing Radiation Hazards," Journal of the Franklin Institute, December 1973, pp. 485-97.*

Further, he mentions that some sections of our largo cities would need to be evacuated unless radiation from the broadcast antennas was reduced. How is it that tho various industries can justify such exposure levels? For one they point to therapeutic applications of radiofrequency energy. Industry spokesmen would like us to accept that since higher levels of radiofrequency energy are used for medical applications such exposures must be suitable for the general population.

But should the general population moving about the cities and countryside be bombarded by therapeutic doses of radiation? Should the general population, going about its everyday business, be subjected to doses of radiation that effectively raise the internal temperature of parts of their bodies and result in biological modifications?

15

J . A. D'Andrea performed experiments with laboratory rats to determine at what power densities behavioral effects could be observed.[118] The rats were trained to press a lever for food and the effects of radiofrequency radiation were determined by observing variations in the performance of the rats. Behavioral effects were observed in the test subjects for exposure to 600 MHz radiation and at a power density of 7 .5mW/cm^2. The behavioral effects were documented as work stoppage. More accurately, the rats stopped working for food. At higher power levels, 20mW/cm^2, the rats stopped the activity sooner.

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[118] *J. A. D'Andrea and O. P. Gandhi, "Behavioral and Thermal Effects of Microwave Radiation at Resonant and Nonresonant Wavelengths," Radio Science, November—December 1977, pp. 251-56.*

It should be noted that the researchers did not consider a behavioral effect—work stoppage—until the rate of work dropped to 33 percent of the average the rats were trained to perform. Clearly, something was happening to the rats much sooner than the "threshold" point that, was defined as an "effect."

Consider such a gross change if it were to take place with human performance. For example, a brick mason may lay about 900 bricks during a full day of work. According to the guidelines defined previously for behavioral change, the bricklayer would only be classified as exhibiting a behavioral effect when his production fell to 300 bricks a day. We can all be fairly confident that by then he'd already be looking for a new job, or he'd be out of business if he were a private contractor.

Consider further how the same effects in laboratory animals would be expected to show up in human activity. Consider athletes as a next example. Most professional athletes are specialists within the overall game. Football has its premier receivers, and basketball has its all star shooters. Baseball is known for its Golden Glove fielders and excellent hitters. But what might we find when any of these specialists is impeded, as were the laboratory animals in the previous experiment? How about unexplainable fumbles, poor shooting percentage, fielding errors, and low batting average, which appear from one season to another or seemingly overnight and persist without apparent cause?

Aside from the curious way of defining when an effect was present or absent the researchers have provided valuable information. Since the exposure levels from portable cellular telephones may exceed 7.5mW/cm² it should be apparent that radiation absorption in some areas of the human head is at least as high as that which causes

laboratory animals to cease an activity that provides them with food.

Some years later, during 1986, these same researchers performed a long-term radiation exposure experiment during which rats were irradiatied with low-level radio-frequency radiation. During and after the exposure the rats were tested and evaluated to determine the presence of any physiological and behavioral effects. The results showed that the radiation exposed rats suffered from aloss of ability to perform tasks for which they were previously trained. The researchers felt that the performance deficiencies of the rats were not significant enough to form a definite conclusion. Therefore, they reran the experiment at a higher radiation exposure level.[119] That is, even though there was some deficiency in the performance of the rats, the researchers decided not to state an effect at the original exposure level. They chose to repeat the experiment at a higher exposure level.

This second report by D'Andrea, et al., included similar experiments during which rats were exposed to radiofrequency radiation for fourteen weeks. The researchers found that

> ***significant differences between the two groups were also observed when the rats were tested after the 14 weeks of intermittent microwave exposure.***

The two groups to which they refer are the exposed and control groups. The differences, once again, are a diminished capability to perform tasks for which the rats had been previously trained. In the instance of this second

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[119] *J. A. D'Andrea, et al., "Behavioral and Physiological Effects of Chronic 2,450-MHz Microwave Irradiation of the Rat at 0.5mW/cm^2,". Bioelectromagnetics 7, no. 3 (1986):45-56.*

experiment the researchers point out that the effects remained even thirty days after the exposures were ended.
They comment:

This decrement in performance of the schedule-com trolled behavior becomes more prominent as the dose-rate is increased from 0.5 to 2.5 mW/cm².[120]

Research into the physiological and behavioral aspects continued, during 1988, with additional evidence that exposure to radiofrequency radiation results in memory deficits and motor skill loss. C. L. Mitchell, et al., found that rats exposed to radiation at a power density of 10mW/cm² suffered from degradations in "locomotor" capability. This decreased motor activity was also accompanied by a decrease in "startle response."[121] In other words, the test subjects were not alert to danger in addition to suffering the reduction in motor skills. These findings are consistent with earlier research results that also indicated loss of motor skills as a result of exposure to radiofrequency radiation.

The memory deficits that have been observed in the laboratory rats have also been indicated in humans exposed to radiofrequency radiation. One method of monitoring such effects is by use of the electroencephalogram (EEG). Changes in EEG readings that persist for days or weeks after radiation exposure has ended are indicators of long-term modification to brain activity. These modifications have been observed in the rats as an inability to

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[120] J. A. D'Andrea, et al., "Intermittent Exposure of Rats to 2450 MHz Microwaves at 2.5mW/cm²: Behavioral and Physiological Effects," Bioelectromagnetics 7, no. 3 (1986):315-28.

[121] C. L. Mitchell, et al., "Some Behavioral Effects of Short-Term Exposure of Rats to 2.45 GHz Microwave Radiation," Bioelectromagnetics 9, no. 3 (1988):259-68.

carry out tasks for which they have been trained. In humans such EEG brain activity changes would be observed as diminished memory and capability to perform manual tasks that require motor skills. Some motor skill tasks include operation of an automobile and participating in skilled sports. Note that since the brain activity modifications continue for up to weeks after exposure, the corresponding deficits in operational performance will also continue.

Such mental degradations in humans are clearly a danger to those operating motor vehicles or machinery. Oftentimes it's our startle response that allows us to react to situations and avoid accidents. If a decrease or blockage of the startle response is coupled to a generalized decrease in mental activity and motor skills capability the combination points to the prospect for increased accidents and injuries.

16

In a first report on the effects of modulated radiofrequency radiation A. R. Sheppard, Bawin, and Adey confirmed that low —intensity modulated (16Hz) 450MHz fields produce modified calcium efflux through brain cell membranes. The researchers observed the effect for power density levels lower than 2.0 mW/cm² [222] Significantly, the cellular telephone system in the United States currently operating as an analog system, is in the process of changing to a digital signal system. A digital system

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[222] *A. R. Sheppard, et al., "Models of Long-Range Order in Cerebral Macromolecules: Effects of Sub-ELF and of Modulated VHF and UHF Fields," Radio Science 14, no. 6S (November-December 1979):141-45.*

utilizes low-frequency switching, such as those that these researchers are investigating.

At the same time, it is also necessary to consider that even the analog system, although thought by some to operate at a single frequency, does in fact operate with frequency modulation. Electronic circuitry used in handheld cellular phones may also allow the transmit frequency to change over small ranges that is effectively the same as the frequency modulation used by the researchers. In effect, these research findings are relevant for both systems.

Evidence that weak modulated radiofrequency radiation causes effects at the level of individual cells is significant since it brings out another mechanism for interaction. This interaction is distinctly nonthermal in nature. It has been proposed by Adey that communication between cell occurs along pathways between the cells and that interruptions in the communications may lead to disruptive growth. The findings of modifications in passage of calcium through the cell membranes provides a basis for continuing the work along those lines.

H. P. Schwan and K. R. Foster have also investigated the possibility of weak field interactions with biological tissues. In their work the researchers do not describe any theoretical interaction mechanism, but they do confirm earlier findings that the cell membrane plays an important part in determining the cell electrical characteristics with respect to radiofrequencies.[123]

At this opposite end of the energy exposure issue, low-level exposure, we find that researchers are consistently reporting biological effects at surprisingly low radiation levels. In very early experiments, conducted to

[123] *H. P. Schwan and K. R. Foster, "RF-Field Interactions with Biological Systems: Electrical Properties and Biophysical Mechanisms," Proceedings of the IEEE 68, no. 1 (January 1980).*

investigate microwave induced hearing sensations, J. C. Lin confirmed that a biological hearing effect is induced at power density levels hundreds or thousands of times lower than levels previously thought to cause any effects. In essence, Lin confirmed what USSR researchers have been insisting all along. That is, the exposure limits in the United States and other Western countries are much too high and not really based on biological effects.

Interestingly, the IEEE/ANSI standards are claimed to have been established at a level that is ten times lower .
Than any measured biological effect. But in 1977 Lin demonstrated just such an effect at levels much lower than the limit of the safe exposure standard. The effect was described as a thermal shock wave caused by a rapid expansion of tissue due to energy absorption and propagating within the brain. Today's "safe level" of radiofrequency exposure remains at least 100 times higher than the threshold levels found by Lin. At that time Lin stated:

The effect is of great significance since the average incident power densities required to elicit the response are considerably lower than those found for other microwave biological effects and the threshold average power densities are many orders of magnitude smaller than the current safety standard of 10mW/cm².[124]

In a follow-up, or follow-on, to previous research reporting modifications in brain cells at low-level radiation exposure W. R. Adey also reported that weak modulated radiofrequency radiation results in major physiological

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[124] *J. C. Lin, "On Microwave-Induced Hearing Sensation," IEEETransactions on Microwave Theory and Techniques MTT-25, no. 7 (July 1977):605-13.*

changes. These weak exposures, less than that which would result in temperature increases of 0.1°C, have also been observed to produce chemical and behavioral changes. Adey's findings indicate a particular sensitivity of brain tissue to radiofrequency radiation exposure that is modulated at between six and twenty Hz (cycles per second).[125] One way of observing this sensitivity is to record the changes in the brain wave patterns (EEG) of humans and other animals as they are exposed to the low—level radiation. In some cases the modified EEG patterns persisted for several days. Adey has proposed that the radiation fields lead to a disruption of inter-cell communication and that the disruption of that communication can lead to uncontrolled cell growth. But, the safety standards do not consider that low level radiofrequency energy absorption reorients cells or disturbs the equilibrium of biological and electrophysical processes of cells within the brain of humans.

These researchers have long been engaged in the investigation of the effects produced in brain tissue as a result of low-level exposures to radiofrequency radiation. Typically, they employ radiation levels low enough to rule out any measurable tissue heating and concentrate instead on the effects of low frequency modulation of the applied frequency. In their most recent report they state that

Evidence has accumulated that sensitivity of brain tissue to specific weak oscillating electromagnetic

[125] *W. R. Adey, "Frequency and Power Windowing in Tissue Interactions with Weak Electromagnetic Fields," Proceedings of the IEEE 68, no. 1 (January 1980):119-25.*

fields occurs in the absence of significant tissue heating.[126]

The sensitivity includes modifications of the passage of conductive ions through the membrane of brain cells.

The researchers go on to explain that the passage of calcium and potassium ions through the brain cell membrane is fundamental to brain activity. Disturbances in this communication link are shown by modifications to the EEG readings of test subjects. These modifications have been/demonstrated and documented by these and other researchers, as described earlier.

During 1988 S. F. Cleary presenteda review of the state of research related to nonthermal interactions and effects of radiofrequency radiation. His conclusions include the understanding that

> ***cellular studies provide convincing evidence that RF radiation, and other types of electric or magnetic fields, can alter living systems via direct nonthermal mechanisms, as well as via heating.*** [127]

Cleary also pointed out that since there was, at that time, a lack of understanding about the interaction mechanisms and effects of low-level radiofrequency radiation exposure, the safety standards should be considered only an interim expedient. More specifically, the safety standards established during 1982 were only a guess.

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[126] *W. R. Adey and S. M. Bawin, "Binding and Release of Brain Calcium by Low—Level Electromagnetic Fields: A Review," Radio Science 17, no. 5S (September—Cctober 1982):149S—57S.*

[127] *S. F. Cleary, "Biological Effects of Radiofrequency Radiation: An Overview," Electromagnetic Biointeraction (New York: Plenum, 1989), pp. 59-80.*

S. Szmigielski proposed that cellular or systemic damage may be related to long—term exposure to weak electromagnetic fields. His basis for such a proposition is tied to the many reports of behavioral, neurological, and reproductive abnormalities resulting from such exposures.
He also finds that

"there were no evidences and arguments to support this view . . . that EMFs were not carcinogenic."[128]

In other words, there never has been any evidence to indicate radiofrequency radiation is less harmful than X rays or UV radiation.

There is nothing inherently special about radiofrequency radiation that should make it less harmful. Simply because the scientific community has not established the specific interaction mechanisms does not warrant premature claims regarding safety. The industry and government have not performed research to warrant any claims of safety.

The industry claims of safety amount to a belief system but not science. They have repeated the wishful thinking among themselves so often and for so many years now that they have come to think that it has some basis, but it has none. The industry would have us believe that since only some of the research provides evidence of tumor growth and mental function effects there is no scientific proof of danger.

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[128] *S. Szmigielski and J. Gil, "Electromagnetic Fields and Neoplasms," Electromagnetic Biointeraction (New York: Plenum 1989), pp.81-98.*

For example, if someone throws 100 darts at a balloon and only the last dart thrown strikes and breaks the balloon are we to conclude that darts do not break balloons? Are we to interpret the results as an average of all the darts thrown? The average indicates that thrown darts do not break balloons. But we surely know that one well thrown dart will indeed break the balloon. More likely we conclude that the previous ninety-nine tests, or experiments, did not provide accurate results.

Let's apply the same basis for judgment with respect to the hundreds of reports of experiments and computer analysis related to biological effects due to radiofrequency radiation exposure. Some of those reports provide no findings of excess energy absorption, excess heating, or biological effects of any kind. But not finding an effect doesn't mean that there is no effect. It just means the research experiments did not find it—the "darts" may have missed the target.

However, much of the research provides experimental findings that do conclude that the absorption of radiation is excessive; that there are local "hot spots" of intense energy absorption in the human brain; that low-level exposures cause mutations of DNA and chromosome structure; and that radiofrequency energy exposure results in memory changes. Just as with the balloon and dart experiment, ninety-nine poorly performed experiments do not wipe away the scientific importance of one valid experiment that shows that radiofrequency radiation has the damaging effects that we now know.

With that in mind we return to Szmigielski's comments on the state of the scientific knowledge of these effects. He states that it appears that two types of neoplasms predominate-leukemias and brain tumor.

Of course, he is referring to radiofrequency radiation as the initiator or promoter of the malignancies.

In his conclusions Szmigielski indicates that there are two problems to be considered:

> ***Increased risk may refer evenly to all members of the population, but the risk may be assessed as tolerable in terms of population and costs of advancing civilization.***
> ***. . . In the population there are individuals that are exceptionally sensitive to the applied factors and these individuals develop neoplasms with enormously high odds and increase the rate for the whole population. Recognition and elimination of sensitive individuals would lower the population rate to normal values.***

Let's consider the two problems one at a time. The first that has been identified suggests that everyone will be at some increased risk, but that somewhere some unknown group of almighty individuals has "assessed the increased risk to be tolerable." That is, if you develop brain cancer the risk is tolerable to the group who performed the assessment. If you die of brain cancer the risk is tolerable as a cost of advancing civilization. That is the decision that the "assessors" have made. Typically those, who assume the burden of a risk are not the assessors of that burden. Usually it's some financially interested group making the decisions—so, too, in this instance. Who decided that the Challenger space shuttle astronauts should assume the risk of an explosion caused by rocket motors not designed for freezing temperatures? Not those at risk.

Who decided that the passengers of a ferryboat crossing the Baltic Sea should assume the risk of sinking because of leaky doors on the ship? Not the passengers.

Who decided that owners of pickup trucks with side-mounted gas tanks should assume the risk of explosion? Not the owners.

Who decided that the owners of portable cellular telephones should assume the risk of developing brain tumors, brain cancer, memory deficits, or increased accidents? Not the owners?

Typically those who make such decisions are the economically interested parties. In the case of the issue at hand, those interested parties include the cellular telephone manufacturers and service providers acting in concert with your government. Make no mistake, the success of the cellular telephone industry is significant revenue business for the government. In addition, the military loves the technology; the FBI loves it; the CIA, the BATF, the INS, the IRS all love it. What's not to like about it? The technology is wonderful. The hidden dangers are the problem. The powers and significant players in government and industry don't want to concern themselves with the real-world issues of danger and damage to the population. They, instead, determine that the population will assume an "acceptable risk."

And so we progress to the point where some researchers, in concert with the industry interests, propose cost/benefit decisions, biased epidemiological studies, and "risk assessment" as a balance for their conclusions that radiofrequency radiation is dangerous, all of which is coupled with regulatory agencies proposing multiple "options" for safety standards, some "less costly" than others.

How is it that they have not expressed any concern for human safety? Isn't that the purpose of all of this research?